The Net has taken the world by storm—but now a network within a network could be even more exciting.

Multicasting for the Masses

Here's an introduction to the MBONE and what it can do—plus a peek into the evolving future of this technology, which may make it more accessible to you.

IN ITS SHORT HISTORY, THE INTERNET HAS SEEN MORE THAN ITS share of revolutions. First came the revolution in global communications with e-mail and Usenet newsgroups. After that, there was the revolution in information sharing with FTP and gopher. In the past few years, the World Wide Web has revolutionized the presentation and distribution of information. Another revolution is just around the corner—one that promises to meld the multimedia pizzazz of the Web with the down-to-earth usefulness of electronic mail.

"Multicasting" is to the Internet what broadcasting is to the airwaves: a way to efficiently transmit information to anyone and everyone who wants to receive it at that moment. Audio and video, chat-room conversations and Usenet newsfeeds are sent by one source but received by thousands.

Illustration: Stuart Bradford

By Kevin M. Savetz

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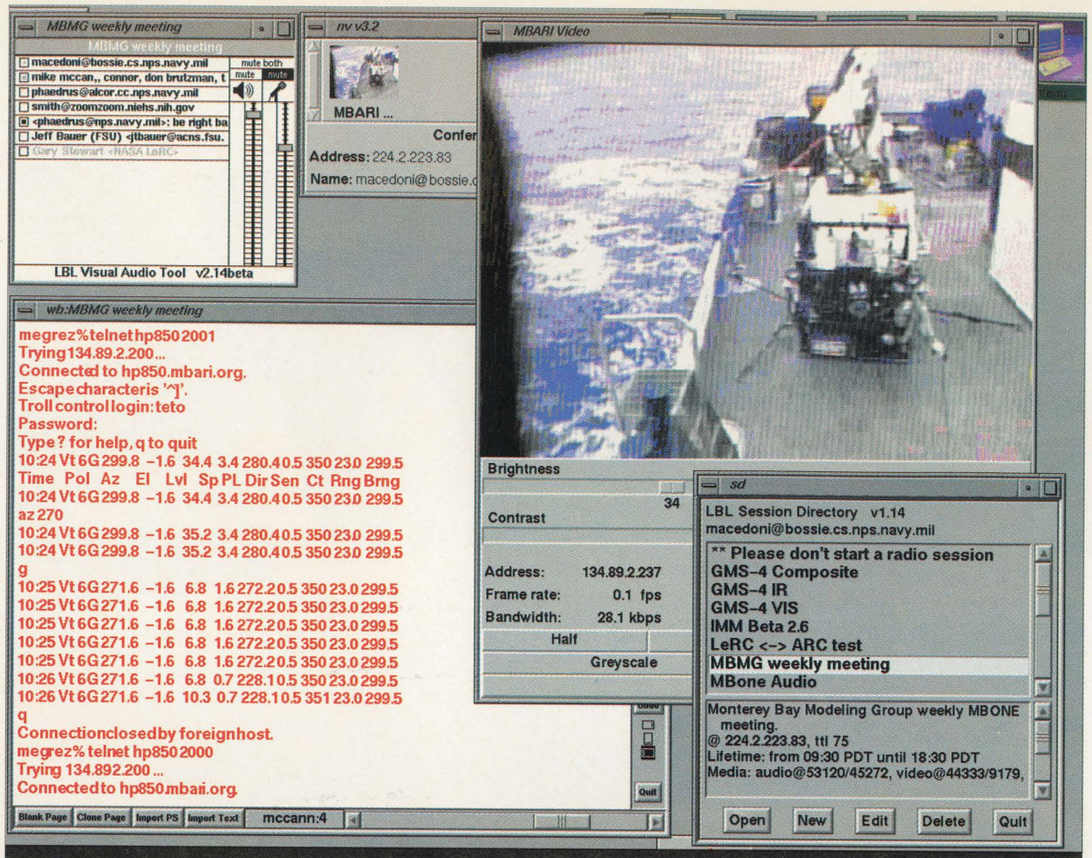


Multiple MBONE applications in use, including "nv," for monitoring network video, and "sd," a session directory tool to see what events are happening on the MBONE.

Data on Parade

The usual way of moving information around the Internet is with "unicast" protocols. Today's Web servers, electronic-mail hosts and streaming multimedia sites send each individual user (or client) his own copy of every packet. If 200 users connect to a Web site to hear a live concert that's being transmitted with *RealAudio*, for example, the server must send out 200 identical copies of every sound packet—causing a tremendous load on the server and using a frightening amount of bandwidth.

On the other hand, if the server site were to use a multicasting protocol, it could send just one stream of packets into the ether—and any number of users could tune in to the signal, with no extra load on the server. Multicasting changes the rules of the road: It allows packets of information to be "broadcast" to anyone who is "listening," rather than to a single, specific computer. These packets aren't sent individually to each recipient; instead, only one stream is sent, but it is received at all the destinations at (more or less) the same time.

Multicasting may eventually make it possible for anyone with an ISDN line (at 128kbps, more than four times faster than a 28.8k modem) to produce an Internet-only television channel, without so much as an FCC license or a transmitter. Or teach in an online classroom with students in ten different states. Or participate in an important videoconference with researchers from around the globe.

Multicasting lends itself to a whole new way to publish information on the Internet. Instead of the electronic equivalent of a one-on-one chat, you can have a megaphone, broadcasting to everyone who cares to listen. And if you want them to be able to talk back, the people who are listening can reply, not just to you but to everyone else who is tuned in to the conversation.

MBONE: Good News, Bad News

The first attempt at creating a viable multicasting system, although certainly not the last, is called the MBONE (short for "multicast backbone"). Over the past few years, the MBONE has been making its way into the research labs and universities of the world. Today, there are about 1,700 networks (in about 20 countries) on the MBONE, meaning the MBONE is available on approximately 3% of the Internet. Although the MBONE itself may never make its way into your computer room, multicasting in some form definitely will.

The good news is that the MBONE works, and it works well. It has proven itself as a viable Internet resource—today, MBONE-connected users can catch video feeds of Internet Engineering Task Force meetings, listen to a collaborative radio station called "Radio Free vat" and have virtual meetings with colleagues hundreds of miles away.

Here's the bad news, though: The bandwidth that's needed to get on the MBONE is beyond the reach of most Internet users—you'll need at least 384kbps to send and receive voice and video with the MBONE...and a T-1 (1.544 megabits per second, more than 50 times the speed of a 28.8kbps modem) is preferable. A multicast video stream of one to four frames per second, for instance, eats about 128kbps of bandwidth.

Audio multicasts, partly because of their lesser bandwidth requirements, are more common on the MBONE than video. Multicast audio typically uses 56 to 64kbps of bandwidth. (Other encoding mechanisms that can be adapted for multicasting manage to send audio and video with less bandwidth, and with lesser quality. We'll talk about those in a moment.)

It helps if you have a high-end UNIX workstation, too, since most of the software for moving, encoding, decompressing and manipulating MBONE packets is only available for UNIX and Linux computers. This requirement is slowly fading as new tools are developed. Precept Software, Inc. at **http://www.precept.com/** offers a product called *Flashware* that enables you to send and receive information on the MBONE with Windows; similar tools for the Macintosh are not far off.

Here's more bad news: Even if you have the software and the bandwidth to spare, your service provider needs to be set up properly for you to use the MBONE. You'll need an "IP tunnel" to be configured, connected to another site that is part of the MBONE. This may be the kind of thing that causes your network administrator to go postal, quit his job or flee the country.

Better News: Multicasting Sans MBONE?

MBONE is a good first try, but it doesn't look like it will ever be viable in the 28.8kbps (and slower) world of consumer Internet users. Several companies are trying to build on the advantages of MBONE, while avoiding its drawbacks. Most of us would be content to see live video in a window only a little larger than a postage stamp, as long as it worked with our 14.4k modems.

Most of today's audio- and video-streaming applications, such as *RealAudio, VDOLive* and

The good news is that the MBONE works, and it works well.

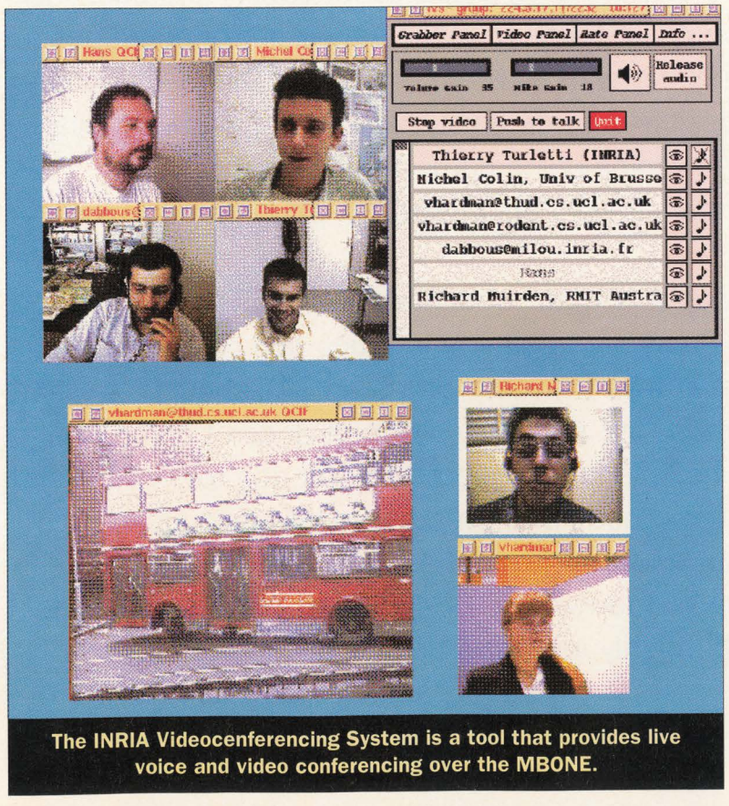
StreamWorks, work best as "media on demand" tools—that is, they'll happily serve you information when you want it. If you want to stop the audio for a trip to the kitchen or to rewind a segment, you can.

Live events, such as those presented at Apple's QuickTime Live Web site (**http://live.apple.com**) draw more users at once, and thus require more server power. For live events, multicasting is the answer. VDOnet is one of several companies that provides a media-on-demand streaming video client. Like other mainstream tools, its *VDOLive* program works well for a few simultaneous users, but does not scale well to larger numbers. Therefore, VDOnet is developing a tool that supports multicasting.

Ori Cohen, Director of Technical Marketing for VDOnet, is helping to develop VDOcast, a multicasting system suitable for today's modems. "We are trying to do something considered impossible a year ago: real-time video on the Internet. There are two problems...the first is bandwidth—using a T-1 line, you can simultaneously serve a 20kbps stream to a maximum of 60 or 70 people. The second issue is quality of service. As data passes through the Internet from the server to the client, there is no guaranteed quality of service," Cohen said.

"There are two ways to approach scalability," Cohen continued. "More servers and more bandwidth. This is the most common solution on the Internet today. Really, you end up with a system that is not economically effective. The approach we took solves both these problems. Multicasting scales up to as many users as we want, and we're going to be able to guarantee a base quality of service to those users."

The VDOcast system would send a single stream of data to each network, as close as possible to the user without sending directly to the user. For instance, VDOnet would send a single stream to netcom.com, which could then be delivered to all of Netcom's 500,000 users. This means VDOnet would only have to send a data stream to each network, instead of to every user. Like the MBONE, this requires that each Internet service provider configure its network to feed multicast data to their users. VDOnet will work with ISPs to upgrade their systems.



The INRIA Videocenferencing System is a tool that provides live voice and video conferencing over the MBONE.

The More, the Merrier

Cohen estimates that at first, VDOcast will support up to ten simultaneous data streams, or channels. VDOnet has partnered with NBC and PBS for content—will you be able to watch *Friends* on the computer screen? "I really hope that doesn't happen," he said. "We are not competing with television. We aren't another cable channel. We want content providers to generate specific content for the Internet. At 20kbps, video is not TV quality." There's no point of putting NBC on the Internet because you can switch on your TV to see it more clearly.

Content providers will need to learn to utilize the Internet's own benefits. For instance, Cohen suggests that while television news is good for distributing news highlights, the Internet might be used to distribute unedited news, such as Olympic games that don't get much air time, or gavel-to-gavel coverage of a Congressional debate. "Content providers need to generate more creative content for Internet, not repurpose content." For instance, PBS intends to offer programming using VDOcast, including a live, interactive series of educational videoconferences for colleges and universities.

Will VDOcast and its competition kill the MBONE? Probably in time—but it's more an inevitable improvement than anything else. Like the MBONE, VDOcast is meant to further evolve the technology of the Internet, but it isn't a final answer to streaming data.

As the Internet usage grows, the load on the network grows proportionally. Multicasting is one way that Internet users can make more effective use of a limited amount of bandwidth. DZ

Kevin Savetz (savetz@northcoast.com) is author of *MBONE: Multicasting Tomorrow's Internet*, published by IDG Books. Check out his MBONE page at http://www.northcoast.com/savetz/mbone.

MULTIFACETED MULTICASTING

Multicasting enables you to...

- collaborate with colleagues in real time using a shared virtual "whiteboard" for notes and illustrations.
- hear and see live lectures from famous professors or scientists, and even ask them questions.
- listen to radio stations "broadcasting" on the Internet.
- start your own radio show.
- see live pictures of spacebound NASA astronauts working on the Space Shuttle.
- attend a virtual poetry reading, hearing the speech in the author's own voice.
- see and hear rehearsals of up and coming Silicon Valley garage bands.
- attend an Internet Engineering Task Force meeting without leaving your office.

And although the following things haven't happened yet, in the future multicasting tools may allow you to...

- watch a customized version of CNN right from your computer's desktop.
- engage 5,000 other people in a huge intercontinental computer game.
- see reruns of *Gilligan's Island*, and share your snide comments in real time with far-away friends.
- put your own garage band's rehearsals online for all to hear (and see).
- automatically download and install authorized upgrades to your computer software, without your intervention.
- "chat" in real time with 20 others—like the current Internet Relay Chat, except using your voice instead of your overworked fingers.
- do plenty of other things that haven't been thought of yet.

—***K.S.***